REMARKS

Claims 1 – 45 are pending in the subject application. Claims 1-9, 11-23, 26-39, and 42-45 stand rejected, and claims 10, 24, 25, 40, and 41 are indicated as containing allowable subject matter. Favorable reconsideration of the application and allowance of all of the pending claims are respectfully requested in view of the following remarks.

Applicant thanks the Examiner for granting the recent personal interview to the undersigned attorney. The discussion in the personal interview focused on the issue of whether it would have been obvious to replace the BPSK modulation used in Spilker's majority voting scheme with the interplex modulation scheme described in Butman. Applicant respectfully submits that this substitution would not have been obvious for the reasons explained below.

Claims 1-9, 11-23, 26-39, and 42-45 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,044,071 to Spilker, Jr. in view of a publication by Butman et al. Applicant respectfully traverses this rejection for the following reasons. For completeness, Applicant has included both the original arguments presented in the previous response as well as rebuttal arguments that focus specifically on the key issue of substituting interplex modulation for standard BPSK modulation, which appears to be the crux of the Examiner's argument.

Original Arguments

As reflected in each of independent claims 1, 15, and 31, the invention relates to using the combination of majority voting and interplex modulation to combine a plurality of signals into a constant-envelope composite signal for transmission. Majority voting is a known technique for combining signals to form a constant-envelope composite signal, as explained in Applicant's specification and as described by Spilker. Likewise, as explained in Applicant's specification and as described by Butman, interplex modulation is also a known technique for combining signals to form a constant-envelope composite signal.

However, as also explained in Applicant's specification, both majority voting and interplex modulation have inefficiencies in certain situations. Majority voting can become

inefficient with a larger number of signals, and interplex modulation can become inefficient if the relative powers of the signals differ significantly. What Applicant has discovered is that these inefficiencies largely can be avoided in certain situations by using a combination of majority voting and interplex modulation. As recited in claim 1, for example, a subset of a plurality of signals to be combined in a constant-envelope composite signal for transmission are combined by majority voting to form a majority voted signal. The majority voted signal and the remaining signals are then combined via interplex modulation to form the constant-envelope composite signal for transmission. The use of these two techniques in the claimed combination can avoid the inefficiencies inherent in majority voting and interplex modulation individually.

While both majority voting and interplex modulation are well-known techniques for generating constant-envelope composite signals, there is no suggestion anywhere in the prior art to employ a combination of these two techniques. More specifically, it would not have been obvious from the prior art to combine a subset of signals via majority voting and then to combine the remaining signals and the majority voted signal via interplex modulation to form a composite signal for transmission, as required by the independent claims.

No combination of Spilker and Butman would have rendered obvious the claimed combination of majority voting and interplex modulation. These documents teach nothing more than what is already described in the background section of Applicant's specification; namely, that both techniques represent a significant improvement in power efficiency over conventional PSK/PM techniques. Note, in particular, the passages on page 2, lines 4-6 and 15-18 which specifically point out that these techniques provide a significant improvement over PSK/PM. What is lacking in Spilker and Butman, taken in combination, is any suggestion or motivation to use both majority voting and interplex modulation in combination.

Applicant respectfully submits that the Examiner misinterprets what Spilker teaches. Contrary to the Examiner's assertion, Spilker does not involve or suggest combining five signals (or the need to combine five signals) for transmission as a composite, constant envelope signal. Rather, Spilker repeatedly and clearly describes combining three signals via majority voting. Reference to combining exactly "three" signals is provided at column 2, line 58-61; column 5,

line 11; column 5, lines 28-30; column 11, lines 52-57; and column 6, lines 22-24. The Examiner lists five signals, arguing that Spilker combines three of the five via majority voting. However, the two other signals listed by the Examiner are local signals that are not transmitted at all, much less as part of a constant-envelope composite signal, as required by the claims. The claims clearly require the majority vote to be performed on a subset of the plurality of signals being combined to form the constant-envelope composite signal for transmission, not just a subset of any set of signals. Thus, the Examiner's apparent suggestion that Spilker has two additional signals that need combining with the three majority-voted signals is incorrect.

As the Examiner correctly points out, Butman teaches interplex modulation. The Examiner argues that it would have been obvious to modify Spilker's BPSK modulator with the interplexing feature taught by Butman "to reduce the cross-modulation loss for improving the performance of multichannel system (Abstract)." Applicant respectfully submits that this argument is incorrect for a number of reasons. First, Spilker has no need for both majority voting and interplex modulation. Spilker's system requires combining three signals to form a constant-envelope composite signal. Spilker discloses combining these three signals via majority voting. Once combined, there is no need for interplex modulation, since the signals are already combined (as explained at length in Applicant's specification (and in Butman), interplex modulation is, like majority voting, a technique for combining signals). Thus, there is no apparent reason why one would have added interplex modulation to Spilker's system, since, after majority voting, there is no set of signals that requires further combining for transmission.

Moreover, the Examiner's stated motivation for inclusion of interplex modulation in Spilker's system is that it would reduce the cross-modulation loss. There is nothing in either Butman or Spilker to support this assertion. As plainly stated in the Introduction section of Butman, interplex modulation reduces cross-modulation power loss relative to a *conventional* PSK/PM scheme. As previously noted, this fact is expressly stated in Applicant's specification on page 4, line 4-6. However, as expressly stated on page 4, lines 15-18, majority voting also "represents a significant improvement over PSK/PM." Butman is completely silent as to whether interplex modulation would provide any power efficiency improvement in the context of

a system already employing majority voting. All of Butman's comparative statements are with respect to conventional PSK/PM modulation. Thus, even if one could figure out a meaningful way to incorporate interplex modulation into Spilker's majority voting scheme, it is not at all clear from either reference, or anything else in the prior art, that the resulting system would be more efficient.

Applicant has determined that it is, in fact, more efficient in certain situations to combine a plurality of signals into a constant-envelope composite signal by first majority voting a subset of the signals being combined and then combining the majority voted signal with the remaining signals by interplex modulation to form the composite signal for transmission. Spilker relates exclusively to majority voting and Butman relates exclusively to interplex modulation. To suggest that combining the two techniques would result in a more efficient approach would require the use of impermissible hindsight gained from the detailed analysis provided in Applicant's own disclosure. More generally, considering both Spilker and Butman together, there is simply nothing that suggests a need for or advantage to using both majority voting and interplex modulation, much less how the two techniques could be implemented in combination. Applicant's discovery that initially combining a subset of the signals by majority voting and then combining the majority voted signal with the remaining signals efficiently produces a composite signal would not have been evident from Spilker and Butman.

Rebuttal Arguments

Based on discussions in the aforementioned personal interview and the rebuttal arguments contained in the Office Action, the gist of the Examiner's position appears to be that Spilker discloses majority voting, which involves RF modulating the resulting majority voted signal via BPSK modulation prior to transmission (see, for example, Fig. 9 in Spilker). As noted by Spilker, BPSK modulation typically involves modulating a data stream in two channels, the inphase (I) channel and quadrature (Q) channel. The Examiner further notes that Butman discloses a two-channel interplex modulation scheme on page 417. Thus, the Examiner reasons,

the BPSK modulation performed on the majority voted signal in Spilker could be replaced by the two-channel interplex modulation taught by Butman, thereby providing Spilker's system with the efficiencies taught by Butman.

Applicant respectfully submits that this critical part of the Examiner's argument is incorrect for a number of reasons. First, the Examiner fundamentally misinterprets what is taught in the Butman paper and the basic nature of interplex modulation. By definition, interplex modulation is used to combine two or more data streams into one composite modulated signal. This fact is clear from the Butman paper, which first introduced the concept of interplex modulation. The "channels" referred to by Butman are different data channels (which, in general, constitute different data streams), not simply I and Q channels within a modulator (incidentally, this is also true of the conventional PSK/PM system described by Butman, which interplex modulation improves upon). For example, Butman states on page 415:

> "However, in doing so power transmitted as cross modulation is wasted and this loss is greater than the power transmitted in one or more of the data channels in conventional PSK/PM systems.
>
> Obviously, it is possible to time division multiplex (TDM) the various data channels onto a single high-rate channel, which is phase modulated onto the carrier."

This passage clarifies that the interplex modulation technique Butman goes on to describe is a technique for transmitting multiple, different data channels on a single RF carrier. It is also clear from this context that cross-modulation loss is a signal loss that results from attempting to transmit two or more data signals on a single RF carrier. In contrast, BPSK modulation of I and Q channels of a single data stream (i.e., the modulation described in Spilker) involves no cross-modulation loss, since only one data stream is being modulated onto the carrier.

The passage relating to the alternative of time division multiplex is also telling. Whereas, TDM is a possible alternative to conventional PSK/PM or interplex modulation (since all three involve transmitting plural data channels on a single carrier), TDM plainly is not a possible

alternative to BPSK, since one would not transmit I and Q channels of the same data signal in alternating time slots.

The fact that interplex modulation inherently involves combining two or more data streams is further clarified by Butman's description of the technique itself. Specifically, on page 416, first column, Butman defines in equations (2) and (3) the expression for the phase modulation of "a binary data stream." From this definition, and from the subsequent description of a two-channel conventional PSK/PM system, it is clear from Butman's description of the two-channel interplex that two separate data streams $s_1(t)$ and $s_2(t)$ are being combined by this technique (see equations (14) through (23)). Again, the notion that this technique can improve upon cross-modulation loss inherently requires that there are at least two data signals involved that could have cross modulation (by definition, a single data stream cannot have cross modulation with itself). In summary, the Butman paper plainly describes interplex modulation as a technique for combining two or more data streams onto a single RF carrier, and the cross-modulation losses described therein relate to losses resulting from combining two or more data streams in this manner.

With this understanding of what Butman teaches, it becomes clear that it makes no sense whatsoever to suggest that interplex modulation could be substituted for BPSK modulation in Spilker's majority voting scheme. The concept of majority voting is that plural data streams are combined (e.g., on a chip-by-chip basis) into a single data stream whose chip values reflect the majority of chip values at each instant. This is precisely what Spilker teaches. Consequently, Spilker's majority voted signal that is modulated onto an RF carrier via BPSK modulation constitutes a single data stream. That is the whole point of majority voting as taught by Spilker. The signal loss resulting from combining plural signals occurs in the majority voting process, not the modulation process: there is no cross-modulation loss during RF modulation via BPSK modulation in Spilker, since there is only one, single data stream being modulated. In any event, interplex modulation (two-channel or otherwise) as taught by Butman cannot possibly be used as a substitute for BPSK modulation in Spilker's system, since there are no signals left in Spilker to combine: there is only one resultant majority voted signal (i.e., one data stream) in Spilker's

system. Moreover, the Examiner's stated motivation for substituting interplex modulation in Spilker's system (i.e., reducing cross-modulation loss) would not in fact occur, since there are not two or more signal with which to have cross modulation. In short, interplex modulation is a technique for combining a plurality of signals to form a constant-envelope, composite signal. It is not a substitute for or equivalent to modulation techniques such as BPSK and could not be used in any obvious way in Spilker's system. Thus, one would not have substituted or employed interplex modulation in the BPSK modulator of Spilker, where there is no need to combine plural different data signals. This need is met in Spilker by the majority voting technique.

Unlike Spilker's majority voting scheme, the claimed invention actually has additional signals to interplex modulate with the majority voted signal, namely, the signals that were not included in the subset of signals that were subject to the majority vote. Nowhere in Spilker or Butman is there any suggestion to perform majority voting on only a subset of the signals to be combined into a composite, constant-envelope signal, as required by all of Applicant's claims.

In view of the foregoing, Applicant respectfully requests the Examiner to find the application to be in condition for allowance with claims 1 – 45. However, if for any reason the Examiner feels that the application is not now in condition for allowance, the Examiner is respectfully requested to call the undersigned attorney to discuss any unresolved issues and to expedite the disposition of the application.

Request for Reconsideration
U.S. Patent Application No. 09/963,669

Filed concurrently herewith is a Petition (with payment) for an Extension of Time of Two Months and a Notice of Appeal. Applicant hereby petitions for any extension of time which may be required to maintain the pendency of this case, and any required fee for such extension is to be charged to Deposit Account No. 05-0460.

Respectfully submitted,

Patrick J. Finnan
Registration No. 39,189

EDELL, SHAPIRO & FINNAN, LLC
1901 Research Boulevard, Suite 400
Rockville, Maryland 20850-3164
(301) 424-3640

Hand Delivered on: April 24, 2006